

3. *A Continuation of a Discourse about Vision, with an Examination of some late Objections against it. By VVilliam Briggs M. D. and Fellow of the College of Physitians.*

HAVING formerly given a ^a *Specimen* of my thoughts about *Vision*, I purpos'd to defer the publishing any thing more relating to it, till a *more entire Treatise* (about the *Particular uses of the parts of the Eye* in *Vision*) had been finish'd, which I intimated my designing at that time; but this will require the consideration of many more years, and indeed the Subject is so admirable, and may be of such use to convince the *Scepticism* of the age, that I hope it will not be time lost: and if I have sufficient opportunities, or be assisted with the *practical Observations* of others whom I dare confide in, I may perhaps add withall the *Pathology* of that *Useful part*, to make it the more acceptable to the World. In the mean time I have been prevail'd with to make *this enlargement* of the forementioned discourse, in order to the fuller explaining my thoughts, and the clearing some difficulties which have been propounded against it.

In that small Essay I endeavour'd to shew. 1. That the *fibres* of the *Optic Nerve*, as rising from the two protuberances of the *thalami Optici*, were more concern'd in *Vision* than either the *Cornea*, *Humours*, or *Retina* (as they are consider'd by Writers in *Optics*); not only because *sensation*

(a) In Mr. Hook's *Philos. Collections* No. 6.

is perform'd chiefly in the *Brain*, and these other parts are but the *transenne* to it; but also because in an *Amaurôsis* or *gutta serena* these parts are free from any indisposition (the *Eye* appearing, *as naturally*, without any fault), tho the *light is then wholly lost*; and therefore those *Fibres* of the *Optic Nerve* must be principally affected, either by ^b being obstructed, or the roots of 'em compress'd (about the *thalami Optici*), by some *tumour*, or too much pent in by a contraction and extenuation of the outward coats of the *Nerves*, or by any *Confusion* or *Contortion* of the said *Fibres*.

2. I shew there that the *superior Fibre* in each *thalamus Opticus* had the *greatest* tension, and the *inferior* the *least*; as may appear from the former arising from the *top* of the *thalami optici* and having the *greatest flexure* thus ; and the latter arising from the *lower part* of the aforesaid *thalami* and having the *least flexure* thus , as may be judg'd from a view of those parts in the *Brain*; so that the *Correspondence* of the former or latter in *site* and *tension* caus'd that correspondence or *Union* in *Vision*.

3. It may be further noted that the *intermediate* or *lateral Fibres* in the same *Eye*, tho diametrically opposite to one another, are said to differ in *tension* (by reason of a more considerable *flexure* of the *external* than the *internal*;) whence two *Stars* or other bodies seen by the *collateral Fibres* of the same *Eye* (whilst t' other may be shut) appear distinct and not as one, because they are viewed by *discord Fibres* of that same *Eye*; which likewise is so kept in its *Orbit* by the *investing parts*, that it can't well be otherwise.

4. I observ'd that the *Optic Nerves* arose ^c *separately* from those two *Molecule* of the brain, and besides have a *peculiar advantage* in rising from these *hillocks* in this manner; whereas the *other Nerves* arise from the *basis* of the brain in a *flatter manner*, and *closer together*, so that the *extream difference* of their rise is very remarkable, and in-

(b) See Bonet, *Sepulchret.* tom. 1. lib. 1. Sect. 18. Observ. 1. 3. & 5.

(c) See Fig. 1. in the fore-mentioned collect. l. l.

tended surely by Nature for some extraordinary end. Thus that of the *Optic Nerves* in order to their *consent* requir'd a *corresponding tension* in their *Fibres*, or else *Vision* had been always *double*, since those *Nerves* arise *separately* from two *distinct eminences* of the brain : but the other *Nerves* arising *closer together* (whereby there may be a *communication* between their *Fibres*,) or belonging to senses that require not so *minute discrimination* of objects as *Vision* does, there need not that exactness in the *placing* or *tension* of the *Fibres*.

5. In the position of the *Fibres* of the *Optic Nerves* I shew that they keep their *distinct order*, and consequently that they are *not mixt* or blended together at the place of their *connexion* (as was frivolously suppos'd by *Authors* before to solve the *Union* of *Vision*). And this I observ'd not only from what is noted in *Man* by *Vesalius*, *Riolan*, and others in their particular remarks in this Case, but also by what *Nature* it self shews in the *Chameleon* and several of the feebler sort of *Fishes*, where they are scarce join'd ; and this she might intend in these small or helpless creatures (who turn thereby their *Eyes* to several objects and *different coasts* at once,) to avoid those on all sides *that infest them*, or to catch the more readily their *fleeting food* ; whereas others that have 'em *closer join'd* view particular objects the better by looking more steadily or *intently* toward one part, and are otherwise provided for in their food or their safety.

6. I observ'd that in the insertion of these *Fibres* into the *Eye* (where the *Medullary part* of them forms the *Retina*) they still kept their *distinct series*, and that they are much kept in ; not only by being fastne'd (or terminating) on the *processus ciliares*, but also by little *transverse Fibres* (that are not described in the *Figure* I have given) which serve to connect those that run a *long-wayes*, there described ; and make the whole *Coat* appear in a glass of clear water like *Lawn* or *Tiffany* as I have shewn. None that I know ever

(c) See the 1. Figure in the former Collections, where the Letters a, b, c, d, &c. in the Eye shew these direct Fibres of the Retina.

did it before me, and those that have mention'd the same experiment since (without taking notice hereof) have mistook my intent in it. For the putting the *Retina* in water is not to wash off the *mucoſus Subſtance*, which is its *proper Subſtance*; but 'tis to *expand the Fibres* by the playing it up and down in warm water, and to *magnific the Image* of it by a *double refraction* of the lucid raies, which paſs through that and the *Glaſs* that contains it.

That there is a little *white ſlimy matter* comes off upon waſhing the *Retina* is true, and this ſerves to *fill up the interſtices* of the Fibres and thicken the Coat, whereby the Raies terminate the better, and paſs not through to the *Chorooides*, (which takes off in ſome meaſure *Mons^r. Mariotte's* objection of which more anon) and this may be part of the *succus Nutritius* of the Nerve; tho however the Coat may be as well ſaid *ſiſtere ſpecies* (as they call it), or to terminate the Raies, as the *Oil'd Paper* does the turning Images in the *Lantern*, notwithstanding it be in ſome meaſure diaphanous. Beſides toward the *bottom of the Eye* the Fibres of this Coat *converge* very much or come cloſer together, and 'tis here that is the moſt lively representation or *exquiſiteſt ſenſe* of the object, for w^{ch} reaſon partly, as alſo partly from it's figure, I formerly took the liberty of calling it a *Pupilla* inverted. This lies in Men diametrically oppoſite^r to the *Pupill*, as the *Optic Nerve* is plac'd in the forementioned figure: but in *Brutes* more obliquely by reaſon of the inſertion of the *Optic Nerve* more toward the inner *Canthus*; ſo that ſometimes (as we may ſee in *Horſes upon ſtarting*) they are forc't to turn their Eye accordingly, to diſtinguiſh clearly objects that ſurprize them.

7. But next of all I would have it obſerv'd, that whereas I ſay the intermediate Fibres gradually differ in tenſion as they are nigher or further from the *top of the Thalami optici*, it may be eaſily ſuppos'd that they do it by ſo *Mi-*

(c) In *Ophib.* p. 30. publiſhed. A. D. 1676.

(f) Fig. 1. In thoſe *Philos. Collections*.

nute Gradations, that the difference of those that are nigher to the Top, from the *Superior* of all, is very little (and therefore cannot make so considerable a difference in the view of the parts of an Object), but from those that are further off great enough, and the difference of the highest fibres from the lowest, greatest of all. Besides I would have it observed that 'tis the *different tension* of the *Thalami Optici*, and not so much a varying Expansion of them in the Eye, that makes the difference. For as the Eye discerns an Object more by the inward than outward ~~cause~~ of Vision: so the *Soul* may be well supposed to judge of or *discriminate* things abroad, not so much by the *outward part* of the fibres inferred in the *Organ*, as by the *inward* that terminate about the *common Sensory* in the brain and more immediately affect her.

8. Whereas I mention sometimes the *parallelisme* of the Correspondent fibres, I mean it not in a strict *Mathematical Sense* (as I partly hinted at the latter end of that Essay,) but only their being as it were in *æquilibrio* or *due poise* in respect of their situation; and therefore if those fibres had been straight (and not of a *Curv'd figure*, as they are) I should have rather chose to have exprest my mind by the phrase of *Mathematicians*, of their being *in eodem plano*. But my sense being understood there need not be any exception to the word, since it was not so easy to express my meaning by a better; and therefore I shall pass by this, and proceed to more real objections that have been sent me by Mr. *Newton* our worthy Prof. of *Mathematicks* at *Cambridge* (and other friends,) relating to the Opinion it self.

The 1. Objection was made in the R. S. when it was read there, which (as I was told) was this; *viz.* That it seem'd difficult to conceive how those *soft Medullary Fibres* of the Nerve could have such a *tension*. But this is not harder to conceive than in that of a *Spiders-Web*, whose *Mucous substance* and *Expansion* very well answers to that of the
Re-

Retina (whilst in its due position or Expansion in the Eye;) and as the least *breath of Wind* moves the one, so the least *gale* of the *Etherial* or *lucid matter* causes a *vibration* in the other.

Further it was objected, That it was hard to conceive how so *soft a body* as the *thalamus Opticus* (being only a protuberance of the *Medullary part* of the Brain) could make such a difference in the Stress or tension of the fibres: But 'tis apparent that upon drawing the Nerve from it forward (according as 'tis situated and runs toward the Eye) the *Superior fibres* are more upon the *Stress* than the *lateral*, and *Nature* in these cases is finer in her operations (or to speak more properly the *great Author* of Nature is) then we are in our Conceptions of them. It seems so especially in the formation of this *Organ*, where the *Apparatus* of its parts in order to vision is so curiously contriv'd by the *great Artist* and all is done as it were in so *fine Miniature* and with so *soft Touches* of his inimitable hand, that it exceeds as much the other parts of the *human body*, as that does eminently transcend the remaining frame of the visible World.

2. It has been objected by others, That if the *Superior fibres* were more tense then the *inferior* we should see better by raies falling on the *top* than the *bottom* of the Eye, or see an object better plac'd below our Eye (when the *raies* passing in a *straight line* from it must terminate in the *top fibres*) then above it, when *vice versa* they must terminate in the *lower fibres*. To this I answer, that it does accordingly fall out so, and this is a more positive and direct proof of my Opinion; for I appeal to any man's experience whether the *Characters in a Book* appear not better to him, or he reads not better in it held about half a yard under his Eye than so much above it; or whether he does not more readily discern or find out objects beneath than above him with the same light: and this may be further illustrated by my ^a L^d, *Bacon's* experiment of a mans appearing better on the ground to him that is plac'd on a high steeple then *vice versa*.

3. It is urg'd That according to my *Scheme* of the situatioⁿ of the correspondent fibres, the Raies of an object plac'd *laterally* (suppose toward the *left Eye*) could not fall upon the *fellow Fibres* in the *right Eye*; for if it were plac'd so slantingly toward the *left Eye* the raies could not fall upon the *internal lateral Fibres* of both Eyes in that position; but upon the *internal* of one, suppose the *left Eye*, and the *external lateral* of the *right*; which would cause a double perception. This Objection I foresaw when I hinted (in p. 176. of the aforesaid Collections) that *Whether the Nerves decussated or not, it would be no prejudice to my Opinion, nay perhaps might more fully confirm my opinion where they do.* In that passage I had respect also I confess to the *inversion of the Image* in the Eye being rectified in the Brain; tho that equally presses any other *Hypothesis*, and the explication of the thing may be well enough understood by a *blind man's* judging of the position of an object *above his head* by touching it with *one end* of his stick, tho the other end terminates *under that Object* or in his hand: And so in our view of an object the true situation of the respective parts is not distinguish'd so much by the means of that end of the ray that *terminates in the Eye* as of t'other end that *touches the Object*, from whence the vibration or *protrusion* comes.

But to leave this which does not so particularly concern me, I come to the objection it self as it relates to my Opinion; and tho it seems at first view the most difficult of all to be answer'd, yet it may be determin'd by the *Experiment it self*, better than by the *Scheme* (in the Philos. Collections), where the Eyes are not drawn in *that position* that is here requir'd. Now let there be plac'd an object near the *left Eye* of any person (but not so near *that Eye* as that the Nose might hinder the rays from falling on the *right*, because it is to be seen with *both*), and whilst that person looks on it let a *By-stander* observe the position of *both Eyes*, and he shall see that the *pupil* of the *right Eye* is turn'd in a *very oblique manner* to the object, whereas the *pupil* of the

left is scarce so at all, whereby there will be *three parts to one* more in the distance of the pupil of the right Eye from the *external Canthus* (as may be judg'd by the proportion of the *White* that appears) then there will be in the other ; so that the position of the right Eye in respect of the left is as in Fig. 5.

- a. *The Object.*
- b. *The left Eye.*
- c. *The right.*
- d. d. *The Pupils.*
- e. e. *Two internal-lateral Fibres.*
- f. f. *Two external-lateral.*
- g. g. *The Optic Nerves.*

Hereby it appears that if the Object be so plac'd that it is seen with both Eyes, the *right Eye* accommodates it self to the position of the *left*, that the rays strike *correspondent Fibres*, and the percussion or *Vibration* being toward the bottom or *Papilla* of the Eye (or near its *Axis*) where I before observ'd *Vision* to be chiefly perform'd, a small turning of one Eye to another will make that accommodation.

Moreover as this accommodation is made in an *oblique position* of the object, so is it more readily done in a *direct position* of the same ; and this we may perceive in an Object's retiring in a *straight line* from the Eyes, whereby the *Pupils* gradually *devaricate* ; as on the contrary, they *converge* when the Object is seen very near them, and that so forcibly that 'tis a pain to hold them long in that posture. Now by this various incidence of the rays sometimes on the *internal* and sometimes *external* Fibres (according as the Object *approaches* or *recedes* from us) its *varying position* in respect of distance from us, is perceived, tho it recedes from us in a *straight line*, and at the same time be *equi-distant* from

from the *Horizon* with our Eyes. In *Brutes* also we see their Eyes accommodate themselves in their viewing a single object : But however the rays seem to fall here more readily upon the *external Fibres*, because of the *oblique insertion* of the *Optic Nerve*, and therefore they do not so indifferently turn their Eyes to *discriminate* the Motion of objects as we do, nor is their *Sphere of Vision* so large.

4. But to proceed to other objections; The case of *Cross'd-ey'd persons by birth* (that are so from a small *contortion* of one of the *Motory Muscles* of the Eye) I have consider'd at the end of the foremention'd ^a *Essay*, and shewn withal why a *Morbid Strabismus*, or more violent contortion of those Muscles *after great convulsions of the Nerves*, causes always a *double Vision* (to which the instances out of *Dr. Willis*, &c. In p. 176. of those *Collections* do refer;) which problem was so hard to consider of by *Plempius*, and others before; and indeed can scarce be solv'd by any other *Hypothesis*.

5. It has been urg'd That the *tension* of all the *Fibres* of the *Optic Nerves* might be *uniform*, notwithstanding the *greater flexure* of the *Superior*; because these latter might be longer, and consequently might not have a greater stress upon the *thalami Optici* than the *lateral*: As, if the arm of a tree grows bent, the *Fibres* on the *protuberant part* seem not more stretcht than on the *concave side*, but to take only a longer compass. To which I answer that sense evinces the contrary in our case (as I shew before), and if any one draws out the *Optic Nerve* straight forward from the *thalamus Opticus*, or as it lies in its *Natural position*, he will plainly see that the *top Fibres* press more on the subjacent *medullary Protuberances* than the *lateral* or, make a deeper

(a) In p. 177. of the *Philos. Collections* No. 6.

impression. Besides to answer one similitude with another, we may observe that *the Fibres* of those Muscles that *extend* the leg, and *bear-upon* the *bow* of the knee, seem more *strect* and vigorous in their action than the *Contractors* that run in the *hollow* under it; and this was admirably contriv'd by the Wisdom of our *great Author* (and may be unanswerably objected to the followers of *Epicurns*, who say the parts of the human body were made *without any design*;) for since those *Extending Muscles* of our *leggs* are much pent up and hindred in their action by the posture of the Child in the Womb (which lies with its knees up to its mouth,) *that defect* is excellently compensated by the *natural tension* and position of the said Fibres, or else *Man* could never go upright.

6. It has been urg'd That the action of Vision was *uniform*, and therefore requir'd an *uniform tension* of all the Fibres. To which I answer, that tho in the view of the *intire Object*, or its place by both eyes, it ought to be so, and that therefore it was done by *correspondent Fibres* (as I have formerly explain'd); yet in a stricter view of *the parts* of the same Object by *one Eye*, there is a discrimination. For to instance in a body of the most simple figure and colour, (as suppose a *Globe all red*, or of *Fire*) that should be seen by *one Eye* only, 'tis certain the Eye distinguishes the different parts in their *extra-positions*, or distinct situations in respect of one another, tho they be all of *a piece* as it were otherwise: and unless it were so, I see no reason why *that red Globe* should not appear only one *red speck*, Or a *Globe* of fire as a *lucid point*: Now this *distinguishing* of the parts is easily conceivable to be done by the *discord Fibres* of the same Eye.

7. Lastly it has been urg'd That the Fibres of the *Chorooides* seem more adapted to Vision than *those* of the *Retina*, because these last did not *sistere species* (to use their phrase) as transmitting the colours of the former; and besides some Blood-vessels running amongst 'em would interrupt the image;

image; and lastly sensation could be better continued to the *Tense Fibres* of the *Pia Mater* by the one, then to the brain by the *softer* of the others.

Although this last Objection does not directly strike at my Notion of Vision (because a *correspondence* of *Fibres* may be understood as well in one as t' other); yet it may not be amiss to consider it particularly; because I have formerly asserted and do still, that *Vision* can be no way better performed then by the *Fibres of the Retina*; however *other senses* may require in their action a greater *stiffness* in the *Membranes* that are subservient to them, which some of late will have to be the only instruments of sense. First then it is certain that (as I said before) the *Retina* is no more transparent if so much as the *old paper* in the *lantern*, which yet serves well enough to intercept the *turning images* of it. Secondly, That being of a *whitish colour*, and resembling thereby the *white Paper* in the dark house, it is fitter to receive the images of *colour'd Objects* then the *dark shade* of the *Choroeides*. Thirdly, It being the more inward or *medullary expansion* of the *Optic Nerve* it can more immediatly transmit any motions to the *Meditullium* of the brain (or the *common sensory*) then the other part, which by its continuation to the *pia mater* does not reach it; and this I urg'd formerly, which has not yet been answer'd by any of *Monsieur Mariotte's* followers. Fourthly, The *blood-Vessels* running upon it is as well an objection against the *Choroeides* (if the latter be not chiefly a *Plexus* of the same as has been lately well argued), because *this Coat* lies under the *Retina*, and consequently under *them* too; and therefore hereby is only prov'd that in some positions of our body, or in *some stations*, we do not so well view an Object as in others, and this is very true. Fifthly, As to the *Tenseness* of the *Fibres*, I before observ'd that the *Retina* has as much as those of a *spider's Web*, and this is sufficient, nay more suitable to the finer strokes of the *etherial or lucid matter* and the *nice actings* of this sense, which is not required

required in any other : and therefore the same objection may lye against the *Constitution of the brain* it self, which consists of soft *medullary Fibres* that are however fit enough to receive or propagate any motion, and whilst they are fill'd with *Animal spirits* may be allow'd to have the like Tensness, or resistance that a *lock of Wool* has, or a Spider's Web. And if I may be admitted to carry on the similitude; As that *little Animal* in the Centre of its soft *circumtended Fibres* is sensible of the least gale of Wind, or is alarm'd by the least noise or *touches of its prey* or of an enemy from any Quarter, by the *delicate expansion* of its Fibres : So may the *Soul* much more (in the *common sensory*) being surrounded by *Fibrillæ of expanded Nerves* and of a finer make; apprehend from what Quarter the several motions come from abroad, and more minutely perceive the difference of 'em in respect of the *diverse Organs* of sense and the different fineness or *tension* of those Nerves that belong to the same.

Some faults being committed by the Press in the *Previous Discourse* to this, in the *Philos. Collections*, *Numb. 6.* may be thus corrected. Pag. 170. lin. 29. for *even and sight*, read *even and insin.* p. 173. l. 28. for *sight*. r. *sic*. In the Margents of pag. 170. 173. 176. to *Fig. 1.* add the Characters *i. i.*